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INTERNATIONAL GEOPHYSICAL COOPERATION PROGRAM -- SOVIET-BLOC ACTIVITIES

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I. ROCKETS AND ARTIFICIAL EARTH SATELLITES

Volume 3 of "Iskusstvennyye Sputniki Zemli" Published

The first volume of the publication Iskusstvennyye Sputniki Zemli (Artificial Earth Satellites) was issued by the Academy of Sciences of the USSR in 1958. The third issue has now appeared. This 125-page symposium-type publication contains thirteen articles. Many of the authors are the same who contributed to the first two issues in this series. These collected articles were edited by L. V. Satsonenko and Yu. Rylina. The manuscript was sent to press on 24 November 1959 and 5,500 copies were printed.

Only the briefest sketches of the contents of these lengthy articles can be given here.

The Problem of Capture in a Limited Circular Problem of Three Points

The limited circular problem of three points in celestial mechanics is the name given to the problem of the motion of the material point m_0 with a negligibly small mass under the influence of the attraction of two point finite masses $\underline{m}$ and $\underline{\mu}$ rotating around a common center of inertia with the constant angular velocity ω. "Capture" in the general problem of three points is that phenomenon in which three points, situated initially at infinitely great mutual distances, approach one another in such a way that after approach one of the mutual distances always remains limited. The point of zero mass, approaching from infinity to the system of finite masses, does not again withdraw from it into infinity, but always remains at distances not exceeding some finite value. This has definite applicability in space research.

The important problem of the "capture" by the Moon of a missile launched from Earth can be solved approximately in rather simple fashion. If the trajectory beginning at the Earth on the first revolution around the Earth enters into the Moon's sphere of action, it is possible (ignoring perturbations) that this trajectory should leave the sphere of action on the first revolution around the Moon. The capture of a missile by the Moon for such trajectories is impossible. In a similar manner, for the system planet-Sun (ignoring perturbations), it is possible to demonstrate that a missile launched from the Earth will not be captured by a planet on its first revolution around the Sun. ("On the Problem of Capture in a Limited Circular Problem of Three Points," by V. A. Yegorov, pp. 3-12)

The Libration of a Satellite

In the first issue of Iskusstvennyye Sputniki Zemli, published in 1958, the author demonstrated that if the kinetic energy of rotation around the center of mass is sufficiently great in comparison with the work of external forces, as was the case in the first artificial satellites, the motion of the satellite consists of the unperturbed motion around the vector of the kinetic moment and secular precession-nutation motion of the vector of kinetic moment.

It is also necessary, however, to examine a case of small kinetic energy. Then, under the influence of external forces, motion of a different type -- librational motion, appears possible. A typical example of such motion is the motion of the Moon.

The present article is devoted to an investigation of the conditions of existence and the stability of the position of the relative equilibrium of the satellite, that is, equilibrium in a system of coordinates connected with the radius-vector of the center of mass of the satellite. Also examined is the librational motion around a position of relative equilibrium.

Because the existence of libration is caused by the character of the action on the satellite of the Newtonian central field of force, we examine only that action, ignoring perturbations from the Earth's compression, aerodynamics, etc. In this form the theory of libration is an idealization of the motions really existing in the solar system (the motion of the Moon relative to the Earth) and motions possible for artificial Earth satellites.

The actual libration of an artificial satellite is influenced by a series of small perturbing factors: moments of aerodynamic forces; perturbing moments caused by the deviation of the Earth's field of attraction from the central field and aerodynamic resistance; moments of electromagnetic forces, etc. The investigation shows that if the basic conditions of stability are fulfilled and several additional natural conditions as well, libration in the presence of the indicated perturbations will differ little from unperturbed libration. ("The Libration of a Satellite," by V. V. Beletskiy, pp. 13-31)

Perturbations in the Motion of Artificial Satellites Caused by the Earth's Compression

Because the Earth does not have a strictly spherical shape, the orbits of artificial satellites deviate notably from unperturbed Kepler ellipsoids. Exceptionally significant perturbations in the motion of satellites are caused by the Earth's compression.

The problem of the motion of a satellite in the field of attraction of a compressed planet is not new. To some degree it has already been examined during the development of theories of the motion of satellites of the large planets, and also the theory of the Moon. However, the orbits of artificial satellites possess a number of peculiarities that cause them to be notably different than the orbits of natural satellites. These are, in particular, the greater inclinations and the greater nearness of the orbits of artificial satellites to the Earth's surface. Therefore former theories of motion, derived for natural satellites having small inclinations to the plane of the equator and situated at a considerable distance from the surface of the planet, generally speaking cannot be used for artificial Earth satellites.

The need arises for a development of a new analytical theory which will be suitable for artificial satellites with orbits at any inclination to the plane of the equator and will be sufficiently precise even for satellites moving in the direct vicinity of the Earth's surface.

In the present article the problem of the motion of a satellite in the field of attraction of a compressed planet is examined with the assumption that the inclination of the planes of the satellite orbits to the plane of the equator may assume any value. It is also assumed that the planet has the shape of a level ellipsoid of revolution and that the planet is quite small. ("First-Order Perturbations in the Motion of Artificial Satellites Caused by the Earth's Compression," by V. F. Proskurin and Yu. V. Batrakov, pp. 32-38)

Perturbations of Satellite Orbits Caused by Air Resistance

If the orbit of an artificial satellite passes over the Earth's surface at relatively low altitudes, in this sector of its orbit the artificial satellite experiences a noticeable braking action due to the air in which it moves. As the result of the periodically repeated process of braking there is a decrease in the satellite's mechanical energy and, as a consequence, rapidly increasing secular changes in the shape and dimensions of the orbit; these lead to a decrease in the elevation of the satellite and its subsequent destruction in the denser layers of the atmosphere.

Peculiarities of the motion of artificial satellites in an air medium have not yet been adequately studied. Therefore the objective of the present article is to derive the general form of first-order perturbations in elements of an elliptical satellite orbit caused only by the resistance of the atmosphere. In so doing it is assumed that the Earth's atmosphere has a strictly spherical distribution of densities and that the attraction of the Earth can be replaced by the attraction of a material point, with inertia in the center and having the same mass as the Earth. With these assumptions both secular and short-period perturbations are derived whose periods do not exceed the period of one revolution of a satellite. As far as is known, these short-period perturbations caused by air resistance have still not been the subject of special study.

This article also contains a numerical example, showing the comparative value of first-order perturbations caused by air resistance.

The research demonstrates that periodic perturbations caused by air resistance are quite small and need not be considered when processing visual and photographic observations of artificial satellites. ("On Perturbations of the Orbits of Artificial Satellites Caused by Air Resistance," by Yu. V. Batrakov and V. F. Proskurin, pp. 39-46)

Observation of Artificial Satellites by the Method of Anticipation

This article proposes a method which will make it possible to make a repeated discovery of a once-observed satellite in a case when its period of revolution is unknown.

We first assume that the inclination of the orbit, the longitude of the node and the position of the perigee are fixed. This is quite satisfactory for orbits that are close to circular polar orbits. In this case it is possible to formulate the following "rule of local time":

> If the inclination of the satellite orbit is not equal to zero, then the intersection by the satellite of any given latitude will always occur at one and the same local sidereal time.

This rule also continues to govern in a case when the period of rotation, eccentricity or the position of the perigee changes. For example, when there is a revolution the point of intersection shifts but the time of intersection, regarded as local time, will have the same value at the new point as it had at any other at which the satellite earlier intersected this same latitude. Figure 1 shows an example of the operation of the described rule.

The presence of a strict relationship between the position of the point of intersection and the time of intersection makes it possible to draw a "graph of anticipation" connecting each direction of possible appearance of a satellite with a completely determined moment of time. Figure 2 shows a very simple example of such a graph. It is possible to draw "graphs of anticipation" even for orbits with changing orientations. The drawing of the graphs and the method of observation are described in some detail. ("Observations of Artificial Satellites by the Method of Anticipation," by V. M. Vakhnin and V. V. Beletskiy, pp. 47-53)

Relationship Between Secular Changes in Orbits and Air Resistance

This paper is a further development of the idea of analysis of secular changes of elements of an orbit, getting simple and graphic formulas which can be used for the solution of a number of problems (determination of the relationship between secular changes of elements of the orbit and the values of the elements themselves, evaluation of the accuracy of determination of air density on the basis of secular changes in the elements of the orbit, etc.). ("Relationship Between Secular Changes in Orbital Elements and Air Resistance," by P. Ye. El'yasberg, pp. 54-60)

The Problem of Penetration at Cosmic Velocities

From the theory of cumulative charges it is known that at velocities of 3-10 km/sec the mechanism of penetration of metal plates by cylinders or small spheres is substantially different from that which operates at velocities up to 1,000 m/sec. At great velocities there are two stages: a) a sphere or cylinder, penetrating into an obstacle, spreads out along the surface of the pocket thus formed; b) after "annihilation of the bullet" there occurs an inertial enlargement of the pocket. Computation of the first stage is accomplished with adequate accuracy in a scheme of an ideally incompressible fluid; computation of the second stage is more difficult although existing results show that the chief difficulties have been overcome. Computations show good agreement with experiments.

The problem of penetration at velocities of 50-100 km/sec has been the subject of far less study. As far as the author knows, there is only one work in the literature that is devoted to this problem -- the work of K. P. Stanyukovich on the formation of the craters of the Moon and the determination of the impact imparted by a falling meteorite. On the basis of his computations K. P. Stanyukovich formulated the hypothesis that on falling of a sphere its kinetic energy is transformed into the potential energy of gas in which matter is transformed as a result of the impact.

In this article the author proposes a model of an incompressible medium for which it is possible to conduct full computations; his conclusions differ somewhat from those drawn by Stanyukovich. ("The Problem of Penetration at Cosmic Velocities," by Academician M. A. Lavrent'yev, pp. 61-65)

Sodium Vapor Diffusion Used for Determination of Atmospheric Density

In recent times our ideas about the basic physical characteristics of the upper layers of the atmosphere -- density and temperature -- have undergone considerable changes. Observations of the braking of Soviet and American satellites have enabled us to determine the density of the atmosphere at heights between 220 and 750 km. It has been learned that density at these levels is many times greater than that derived earlier on the basis of rocket data; it also appears that the temperature of the upper atmosphere is higher than formerly believed.

In view of the exceptional importance of these results it is extremely desirable to get independent confirmation, since data on the density of the atmosphere derived on the analysis of the braking of satellites may contain systematic errors. It is important to note that from observations of the braking of satellites it is only possible to derive the mean value for density. At the present time there is already serious evidence that the density and temperature of the upper atmosphere are subject to local variations. Systematic differences in the main characteristics of the upper atmosphere in polar and equatorial regions should be expected.

The method used for this purpose is an analysis of the diffusion of sodium vapors released in the upper atmosphere from a rocket at a given altitude. Such work has already been accomplished abroad.

In our experiment the height reached by the rocket was 430 km. In the nose cone there were two sodium vaporizers, each of which contained 2 kg of metallic sodium and a corresponding amount of thermite. The thermite is ignited at a predetermined time when the rocket is situated near the peak of its trajectory. The sodium vapors are thrust into the atmosphere through a nozzle in a direction perpendicular to the axis of the rocket which has been stabilized. The process of sodium evaporation requires 10 to 20 seconds. All this time the rocket is not far from the peak of its trajectory.

The described experiment was conducted before sunrise; therefore the cloud of sodium vapors forming as a result of the process of evaporation was illuminated by the Sun's rays.

Figure 1 shows successive photographs of the different stages of development of the forming cloud.

The proposed method for determining the density of the atmosphere can be used for a wide range of elevations. The lower boundary of this range is determined by the condition that during the time of observation (~10 minutes) the sodium atoms do not perish in the Earth's atmosphere due to chemical reactions. Evidently the height should be

200 km. We note that if the experiments are conducted at such relatively low altitudes, the linear dimensions of the cloud at appropriate moments will be approximately ten times smaller than in our case. Under such conditions it is necessary to evaporate a small amount of sodium -- several dozen grams, since otherwise the optical thickness of the cloud will be considerably greater than unity and this would make its photometric analysis impossible.

We may assume that the upper boundary of the atmosphere where the diffusion method is used for determination of density, is situated between 500 and 600 km. However, it is not impossible that the method will also prove suitable for considerably greater altitudes if the hydrogen content there is considerably greater than is ordinarily considered to be the case. Once again it is emphasized that the release of sodium vapors into the atmosphere should be made near the peak of the rocket trajectory and not as described by Bedinger and others.

Simultaneously with determination of the density the diffusion method enables us to determine atmospheric temperature, but the solution of this problem will be the subject of a different paper. ("Determination of the Density of the Atmosphere at an Elevation of 430 Km by the Method of Diffusion of Sodium Vapor," by I. S. Shklovskiy and V. G. Kurt, pp. 66-76)

The Problem of Interference Currents When Using an Electrostatic Fluxmeter

The author has previously proposed the use of an electrostatic fluxmeter of the rotational type for the measurement of the internal charge of a satellite, acquired by the latter under the influence of various kinds of processes, beginning with a diffuse charge caused by a difference in the thermal velocities of ions and electrons and ending with a charge under the influence of ultraviolet rays.

Briefly, the operation of the electrostatic fluxmeter situated in the insulated body, amounts to the following. The measuring plate of the fluxmeter, described in detail elsewhere, is a part of the surface of the body, but the electrical contact with the remaining surfaces is accomplished through the resistance R. It is evident that when there is a fixed screen under stationary conditions the surface of the measuring plate has the same potential and the same density of internal charge as the surface of the body would have in the place where the measuring plate is situated.

Interference currents can be combatted (1) by a synchronous detector or (2) by measuring and screening plates made in the form of metallic grids with a certain electrical and optical transparency or

(3) by the introduction of a negative feedback. Each of these alternatives is described in some detail. ("Methods of Combatting Interference Currents Arising at the Entrance to an Electrostatic Fluxmeter During Its Operation in a Conducting Medium," by I. M. Imyanitov and Ya. M. Shvarts, pp. 77-83)

New Data on the Atmosphere Provided by the Third Soviet Satellite

This paper gives an analysis of the status of ideas prevailing up to 1957 relative to the structural parameters of the upper atmosphere. At that time there were known the mean distributions of pressure, density and temperature up to a height of 100 km and it had been established that the atmosphere up to heights of 90 km was mixed, whereas above 90 km oxygen was dissociated. Up to 1956 there had been very few direct measurements of density, pressure and the composition of the atmosphere and therefore ideas about the atmosphere at these heights differed greatly. In recent years experiments have been made to determine atmospheric density at great heights and an especially great contribution to the study of the upper layers of the atmosphere has resulted from research conducted on the Soviet artificial satellites; these have made it possible to determine the density of the atmosphere both by means of manometers on the third Soviet satellite, in particular, and from the braking of satellites in general. The present article is devoted to an examination of the results of determination of the density of the atmosphere as recorded by manometers on the third Soviet artificial satellite.

Table 1 shows the change in molecular weight with height; Table 2 -- structural parameters of the atmosphere at elevations of 225-500 km; Table 3 -- values for density (in $g \cdot cm^{-3}$) at different heights, based on manometric measurements in rockets and on the braking of satellites. ("Some Results of the Determination of Structural Parameters of the Atmosphere by Means of the Third Soviet Artificial Earth Satellite," by V. V. Mikhnevich, B. S. Danilin, A. I. Repnev and V. A. Sokolov, pp. 84-97)

A Special Mass-Spectrometer for Upper Atmosphere Research

This article is a rather highly detailed and well illustrated description of a mass-spectrometer, presently the only known device for the direct determination of the ion state of the upper atmosphere. When installed in a rocket or satellite traveling through the ionosphere the ion mass-spectrometer transmits readings to Earth by radio; this makes it possible to get data concerning the spectrum of mass of ions, and on this basis to draw conclusions about the chemical composition of the ionosphere.

A mass-spectrometer designed for the study of the composition of the upper layers of the atmosphere should differ substantially from the well known laboratory and factory instruments. Like all apparatus installed in a rocket or satellite, it must be exceptionally reliable, simple in operation, and function automatically for a considerable period without requiring any additional regulations and adjustments. It is necessary that the instrument be subjected to considerable variations in temperature and be resistant to great vibrational and static overloads and maintain itself in operating condition after such stresses. Somewhat contradictory to these requirements are those for small weight and compactness, which the instrument should also satisfy insofar as possible. In addition it is necessary that the mass-spectrometer be economical in power consumption, of low inertia, and satisfy other special demands.

In the Soviet Union investigations of the ion state of the upper layers of the atmosphere were begun in 1957, with data recorded up to heights of 885 km in the ionosphere, using the radio frequency mass-spectrometer described in this article. ("Radio Frequency Mass-Spectrometer for Investigation of the Ion State of the Upper Atmosphere," by V. G. Istomin, pp. 98-112)

Manometric Error From Small Leaks in a Satellite Casing

Among the instruments on the third Soviet satellite were manometers of a type capable of measuring static pressures of $10^{-6} \div 10^{-9}$ mm of a column of mercury under normal ground conditions.

In measurements in the upper atmosphere the manometer may be entered by molecules which have been carried there by the satellite itself or have entered the upper atmosphere as a result of gas liberation from the surface of the casing, or as a result of inleakage. In this case desorption from the surface ceases relatively rapidly, but inleakage inside remains practically constant during the whole period of service of the entire apparatus. Thus, the possibility of the appearance of manometric error places definite demands on the airtightness of the casing.

In this article the term "internal molecules" has been given to those molecules of gas which are situated within the casing; an estimate is made of the manometric error caused by "internal molecules" entering the casing. ("Manometric Error Caused by Small Leaks in a Satellite Casing," by S. A. Kuchay, pp. 113-117)

The Interaction of a Satellite and the Earth's Magnetic Field

It is of interest to examine phenomena associated with the interaction of a satellite and the Earth's magnetic field. Equally interesting is an examination of the electrical processes in the casing of the satellite, inasmuch as they can, to one degree or another, influence the results of scientific experiments conducted by satellite.

This article gives the results of research on the interaction of a satellite and the Earth's magnetic field. First to be examined are currents having as their cause the alternating motion of the satellite relative to the magnetic field, second, the change in velocity of rotation of the satellite around its axis due to eddy currents, and, third, perturbing forces acting from the direction of the magnetic field on a satellite not having its own rotation.

The most important of the factors enumerated is the possibility of the development of eddy currents in the metallic casing; these will lead to a notable decrease in the angular velocity of the satellite's rotation. Charges and currents arising as a result of the alternating motion of the satellite do not exercise a substantial influence on the character of its motion. ("On the Problem of the Interaction of a Satellite and the Earth's Magnetic Field," by Yu. V. Zonov, pp. 118-124)

<u>Danilin Reviews the "Remarkable Prospects" of the Future</u>

Writing in the popular Soviet science magazine <u>Nauka i Zhizn'</u> (Science and Life), B. S. Danilin reviews the details of the launching, flight and mechanisms of the Soviet interplanetary automatic station; these details have been fully reported earlier in this publication. Danilin, however, ends his report with a look to the future, in which he states, in substance, as follows:

We have before us the intriguing possibility of sending to the Moon an autonomously operating Moon observatory controlled from the Earth; equally intriguing is the possibility of seeing our planet through the "eyes" of a satellite or cosmic rocket.

Flying around the Earth in such a vehicle will make it possible to study our planet's irregularity in rotation on its axis and the resultant instability of the duration of earth currents, help to refine the magnitude of the Earth's compression, and solve many present-day problems of astronomy, celestial mechanics, geodesy, cartography, radio communications, meteorology and other sciences.

Flying around our planet in a space vehicle will make it possible to record its visible and invisible illumination, measure its reflective capacity, study thermal exchange with surrounding space, investigate the distribution and movement of cloud masses, discover the laws of ceaseless changeability of the air ocean that to a considerable extent determines the possibility of getting long-range weather forecasts.

The launching of the Soviet cosmic rockets has enabled Soviet scientists to accumulate extremely valuable experience which in the future will make it possible to make flights to other more distant heavenly bodies.

Who is there today that does not dream about flight to the planets nearest us -- to mysterious Mars and cloud-shrouded Venus! There is a rarified atmosphere on Mars, there is water, and there is evidently vegetation. And possibly there are intelligent people?

When can rocket flights be made to these mysterious planets of the solar system? It is very difficult to make any predictions at this time because the secrets of nature are currently being unravelled at a rapid pace -- reality is outpacing the rashest predictions. ("Automatic Interplanetary Station," by B. S. Danilin, Nauka i Zhizn', No. 12, 1959, pp. 2-5)

Man in Space -- Life Under Conditions of Weightlessness

The authors of this article, writing in the popular science magazine Nauka i Zhizn', cover a wide range of aspects of the problem of weightlessness; although written by specialists in the field, the contents are tailored for popular consumption.

The article first describes methods for producing weightlessness and then proceeds to a discussion of the biological aspects of the problem. The only experiments in which an animal has remained under conditions of weightlessness for a long time are the investigations made by Soviet scientists in the second artificial satellite. An analysis of the electrocardiograms for the dog Layka did not show any notable disruption of the functions of the heart. After the animal had been in a state of weightlessness for a sufficiently long time, the electrocardiogram showed a normal picture. Likewise, there is reason to believe that such functions as breathing, digestion and excretion will not be adversely affected. It is therefore believed that the life of man, animals and plants is possible under conditions of partial or even complete loss of weight. The reactions of the nervous system, the matter of orientation in space and the ability of the body to control movements are other problems discussed, but contain nothing not previously reported in detail.

Experiments involving several groups of individuals subjected to weightlessness have revealed a number of interesting facts, but these data must all be treated with serious reservations. Professor K. K. Platonov recommends that special credence be given to the reports of experienced airmen who have repeatedly experienced a state of weightlessness.

The psychic effects of space travel is another problem that is attracting the close attention of Soviet scientists and the authors detail some of the special problems associated with it.

Finally, there is the question of whether a man, on returning from space, will be able to adapt well to the dense atmosphere on the Earth without unfavorable reactions. This is a very serious problem and it is possible that a man will have to relearn how to walk after a prolonged period of weightlessness in outer space.

The protection of man from the unfavorable influence of weightlessness can be attained by means of artificial gravitation in flight by means of the centrifugal force arising during the rotation of the cabin of the space ship. This idea was first proposed by Tsiolkovskiy and at the present time it is shared by many Soviet and foreign scientists.

The authors conclude that the ever-increasing research and the results of recent experiments give reason to believe that life is possible under conditions of weightlessness. The state of weightlessness, arising in each cosmic flight, should not be an insuperable obstacle to the penetration of man into space. ("Man in Space -- The Problem of Life Under Conditions of Weightlessness," by O. G. Gazenko and V. B. Malkin, Nauka i Zhizn', No. 12, 1959, pp. 17-23)

II. UPPER ATMOSPHERE

Soviets Observe Meteor Shower in October

The Earth intersected the orbit of the Jacobini-Tsinner comet on 10 October 1959 and passed through the densest part of the Draconids meteor shower.

The Draconids shower was formed as the result of the gradual decay of the comet and constitutes an immense cluster of meteorite particles with a diameter of about one million kilometers. It revolves around the Sun in an ellipse close to the orbit of the comet. The period of revolution of the Draconids is 6.5 years. The velocity of movement relative to the Earth on encountering this planet is 23 kilometers per second.

When our planet intersects this stream many of its smallest particles enter the atmosphere, and flaring brightly, burn up. Each minute there appear in the heavens several hundred such meteoric bodies of varying brightness. This creates the impression of a "star shower."

Considering the rarity of this phenomenon -- this "meteor shower" can be observed only once in 13 years -- the astronomers carefully prepared for its observation.

Investigations of meteor streams have great importance for the study of processes occurring in the upper layers of the atmosphere and for determination of the danger from meteorites during future flights of Man into space. ("Star Shower," Nauka i Zhizn', No. 12, 1959, p. 71)

Are the Satellites of Mars Artificial?

V. A. Bronshten, Deputy Chairman of the Moscow Division of the All-Union Astronomical Society, reports on our present knowledge of the satellites of Mars in the December 1959 issue of Nauka i Zhizn' (Science and Life).

He begins with an historical account of the discovery of the two satellites of Mars, Phobos and Deimos, by the American astronomer Asaph Hall in 1877. He points out that Jonathan Swift had already predicted the discovery of these two satellites, because the Earth had one moon and Jupiter had four, and to make the universe nice and symmetrical it seemed proper that Mars should have two, even if they had not yet been discovered.

Bronshten points out the reason why the satellites of Mars were among the last of the planetary satellites to be discovered -- it was not their lack of brightness, for many other satellites were less bright, but because they were situated so close to their mother planet.

These two satellites have brightness that is equivalent to stars of magnitude 11.5 and 13. Neither has a visible disk, even in the most powerful telescope. Their size must be estimated on their brightness, it being assumed that they reflect the Sun's light like the planet itself. Computations indicate that the diameter of Phobos is 16 km and that of Deimos is 8 km.

Phobos revolves around Mars three times as rapidly as it turns on its own axis -- the period of revolution is 7 hours 39 minutes, in contrast to 30 hours 18 minutes for Deimos, her sister satellite. The rapid motion of Phobos is the result of its nearness to the planet.

It is possible that Deimos and Phobos have not always been satellites of Mars -- they may have been asteroids at one time, and have now been captured by the planet. Asteroids do approach very near to Mars and the size of Phobos and Deimos is typical of asteroids. But evidence makes this possibility very unlikely.

In 1945 a new riddle appeared -- secular acceleration of Phobos. To be sure, this was not great -- over a 50-year period Phobos was 5 degrees ahead of the point in its orbit that it would have had without acceleration. Two causes are known to science to cause this phenomenon. The first is the action of a resisting medium and the second is tidal braking.

Phobos moves at a distance of 6,000 km from the surface of Mars. Is it possible that at such a distance there can be traces of a Martian atmosphere? The boundary of the Earth's atmosphere lies at an altitude of 2,000-3,000 km, but it is known that the atmosphere of Mars is 10-12 times as thin as the Earth's. On the other hand, the density of the Martian atmosphere decreases with height more slowly than does that of the Earth because the force of gravity on its surface is 2 1/2 times less than on our planet. At an altitude of 140 km it is 10,000 times as dense. Therefore it is possible that at an altitude of 6,000 km there are still traces of a Martian atmosphere.

The second possible cause of the acceleration of Phobos are the tides that it may cause on Mars -- a different case than is true in the case of the Earth and its Moon where the influence is the opposite. Although there are no oceans on Mars there can be "earth" tides as there are on our planet and these could cause the acceleration of Phobos. The problem is complicated by the fact that Deimos is not being accelerated, but quite the reverse.

This problem has been studied by the Russian scientist I. S. Shklovskiy. He first tackled the matter of whether the Martian atmosphere could cause the acceleration of Phobos. Study of the evidence forced him to reject the idea that the motion of Phobos is caused by the action of a Martian atmosphere; at an elevation of 6,000 km it evidently does not attain that density which is necessary to cause this phenomenon.

After rejecting this and other possibilities, such as that of tides on Mars, Shklovskiy has advanced a bold hypothesis.

Up to now we have assumed that Phobos and Deimos have the same reflecting capacity and the same mean density as Mars itself. So it has been easy to determine their size and density. But no one has ever determined their size or mass directly. So what if the density of Phobos is many times less than we have considered it to be up to now? Is it possible that Phobos is hollow? Are both Martian satellites artificial?

Here Professor Shklovskiy goes from strict scientific analysis of observed facts to the field of scientific fantasy.

Let's now assume, says I. S. Shklovskiy, that about 500 million years ago there were more favorable conditions on Mars for the development of life than is true today, that there then existed intelligent inhabitants on Mars with a high degree of development and that they created two giant artificial satellites -- Phobos and Deimos. Shklovskiy then speculates that these artificial satellites were populated by Martians. These Martians died gradually due to unknown causes. It is difficult to say whether it was due to worsening of natural conditions on Mars or to some other factor. These satellites have remained and possibly hold mementoes of Martian culture.

But if the Martians were such highly developed beings why did they not reach the Earth? Seeing that conditions on Mars were worsening, why did they not resettle on our planet? Because, answers Shklovskiy, the conditions on Earth at that time were still less favorable for the Martians. The Martians may have visited the Earth and learned of its unsuitability for life. Movement for them would have been difficult because they would weigh 2 1/2 times as much as on Mars, causing a terrific strain on the skeleton and the atmosphere would have been too dense and moist -- and to such conditions the Martians could not adapt. ("The Riddle of the Satellites of Mars," by V. A. Bronshten, Nauka i Zhizn', No. 12, 1959, pp. 34-38)

Chinese Build New Observatories, Cooperate With Hungarians on Variables

Laszlo Detre, director of the Astronomy Institute (Csillagvizsgalo Intezet), recently returned from China where he spent 3 months studying the work of Chinese astronomers. He said: "Two years ago, at a meeting in Moscow of the International Astronomy Union (Nemzetkozi Csillagaszati Unio) we agreed with leaders of the Nanking observatory and of the Lick Observatory in California that the three observatories should cooperate closely. On my recent trip to China we succeeded in working out a cooperation program. One of the most important tasks of our institute is a continuous observation of so-called variable stars. Cooperation with the Nanking and Lick observatories will now make this observation complete.... In China we sought the best methods to work out the most modern photoelectric astronomical observations, accurate to thousandths.... Five observatories belong to the Nanking chief observatory. One of these is the modernly-equipped observatory now being built at an altitude of 2,000 meters near the South China city of Kunming. A second, being built near Peiping, will be among the largest observatories in the world. It is being equipped with a reflector telescope having a diameter of 2 meters and with much photoelectric equipment. This reflector telescope is being built in China...." ("Cooperation of Three Astronomical Institutes," by T. B.; Budapest, Nepszabadsag, 24 February 1960, p. 6)

III. METEOROLOGY

"Weather Ship"

Photo caption:

The "A. I. Voyeykov," the expeditionary ship of the Main Administration of the USSR Hydro-Meteorological Service, had started on a long trip. The very name of the ship was indicative of its purpose: Voyeykov was a famous Russian scientist-hydrometeorologist, the founder of the science of climatology. Many years ago, acting at his own risk and almost without any support from the Czarist government, he had traveled practically all over the world.

One of the routes covered by the scientists was repeated by the ship bearing his name. Our correspondent traveled 20,000 kilometers on seas and oceans aboard that ship. Following is his story.

The ship had been sailing for almost two months. Navigation charts were piled one on top of the other on a desk in the chart house. Clearly outlined on them was the ship's course. Most of the time it ran far away from the coast and from the known sea lanes. The long route extending across two oceans and twelve seas was traced on the maps. Our ship evoked general admiration not only on the part of the foreign guests in Odessa -- where the expedition began after it had slid down the ways at the Nikolayev plant named after Nosenko -- but also the Suez Canal pilots and Malayan meteorologists.

There had been some suspicion at first: wasn't that really a warship? And if not -- why was there a rocket-launching pad on the bow? Why should a peaceful ship be equipped with three radar screens? Why are black hydrogen-filled cylinders stored in the stern hatches? And why those "No Smoking" and "Danger" signs everywhere? All one has to do, if there is a danger of fire or explosion, is to press a button and all the cylinders will be thrown overboard. And what are those large piles of instruments near the cabin doors, in the bays and deck-cabins? But when it was leanred that there were 38 scientific laboratories on board ship, the people stood enraptured: "How impressive!" Profound respect for the land of Soviets and the steady development of its technology was reflected on the guests' faces when they learned that the ship "A. I. Voyeykov" pursued peaceful purposes as it belonged to the Soviet hydro-meteorological service.

Considerable efforts had gone into the construction and equipment of the powerful floating laboratory capable of exploring the depths of the world ocean and the air ocean above it and sending warnings to all ships, regardless of the flags under which they sail, against storms, cyclones and typhoons.

The launching pad is for launching meteorological rockets.

The hydrogen reserve is to be used for sending radiosondes and pilot balloons into the atmosphere above the clouds, and the purpose of the radar screens is to track their flight, the formation and movement of storm centers. All the collected materials are immediately processed by the scientists: hydrologists, oceanologists, aerologists, hydrochemists, hydrophysicists, mathematicians and synoptical experts..

THREE INTERVIEWS

It is not easy to engage our hydrologists in conversation even if you spend a number of days together with them. In 55 days the A. I. Voyeykov hove to 65 times. For many hours on end, in stormy or calm weather, the work never stopped. Instruments were dropped kilometers deep into the ocean to gather information on the temperature and get samples of sea water. It then took a number of hours to process the samples more than a thousand of which had been collected during the sailing period.

Another blank spot in our knowledge of the world ocean was filled after the trip.

At first glance the work of the hydrologists looks very monotonous, said Alexei Mikhailovitch Muromtseve, doctor of hydrographic sciences and chief of the (section). Day in and day out we lower bathometers into the sea for sampling purposes. These instruments were first constructed by the physicist Lents who had sailed on the Russian ship "Predpriyatiye" (enterprise). The Russian seamen and scientists had laid the foundation for precise scientific observations of the ocean. And we carry them on. There is probably enough work for many generations.

We are learning about the water temperature at various depths, its salinity, density and oxygen content. The material may not look voluminous but it is sufficient to make interesting conclusions about the life in the ocean and the depths of the currents which carry tremendous volumes of water for many thousands of kilometers.

We later learned (not from Muromtsev but from others) that a number of previous expeditions resulted in his monograph on the Pacific Ocean, and that the current trip on the Indian Ocean will enable him to fill a number of gaps in his future book about that ocean.

There was one thing the scientist did not mention, and that is what every expedition meant to him. The severe wound he received 15 years ago appeared to have separated him from his beloved ocean forever. It was like losing the hand that held the crutch. But even if he can no longer be a sailor, what can prevent him from studying the sea? And Muromtsev, now a scientist-oceanologist, is again plying the water lanes. But before every trip he has to fight with his doctors, and he promised them to make this expedition the last one. But in his state room in the evenings Muromtsev discusses future trips and, also, his part in them.

The equipment used by our meteorologists and aerologists is of a different type, said the expedition chief Georgiy Sergiyevitch Ivanov. Dozens of automatic devices are continuously recording the conditions in the air ocean above the sea: the humidity, pressure, temperature, the direction and force of the wind. Every three hours the ship's radio broadcasts its warnings. But now, with technological progress forging ahead, it is not enough to know what is taking place on the surface of the ocean. Radiosondes now help us in the study of the upper strata of the atmosphere, and rockets will be very useful in the future.

Photo caption:

It is impossible to understand, at first glance what all these strange structures are... This is how the weather ship's scientific laboratories look from the aft deck.

An astonishing amount of solar energy finds its way to our earth. How is that energy used up? The problems of radiation is under study by a group of scientists in the actinometric laboratory.

Our third interview with Rustem Fadikhovitch Usmanov, synoptic expert, was suddenly interrupted by the captain: "Are you discussing synoptics? But that is the least reliable and most uncertain science." "Why?" asked Usmanov, embarrassed. "Well, when you say 'rain' the weather is clear. But these are minor things. What is worse is when the weather service predicts calm weather while a 12-point storm is breaking out at the same time...."

From the very start of the expedition the captain never missed a chance to tease the weather experts. And Usmanov never failed to strike back. And so it was this time, too.

"Mikolo Fedorovitch," the weather expert reproachfully shook his head, "you are a progressive captain, but you still judge by yesterday's standards. Just take a look at this: three teletype machines are punching out one line after another. One prints a report from Australia, another from Japan and a third from Indonesia. And each of these reports is intelligible to everyone because the weather information and prognosis are rendered in the uniform international code of the hydrometeorologists."

Photo caption:

How to obtain information on the atmosphere in a so-called vertical cross section? The measurements made for that purpose begin at the very surface of the water from a small boat lowered to the surface. M. V. Kucherov records the temperature, the humidity of the air and velocity of the wind. Similar information covering an altitude up to several thousand meters is being gathered at the same time aboard ship with the aid of instruments and sounding equipment.

"Having spent some time here on the ocean, I can now arrange the weather and prognostic maps not only for the area of our route but also for the vast ocean areas. Could that be done years ago?"

Every day the synoptical experts gather voluminous data. It is not enough to plot them on a map -- a careful account must be taken of all the tornadoes, cyclones and storms. That is why I am deeply convinced that there are few sciences in which so much is demanded of the scientists and so much imagination expected of them. Every weather map is a complete scientific job covering vast areas of the globe, and every prognostic map is a scientific hypothesis.

How many years ago could you first use radio broadcasts? In those days we knew very little of what was happening in the neighboring districts. There were white spots on the maps ... and it was difficult to guess what was going on there. The weathermen did not have the necessary technical facilities then; but today we have calculators, radio-teletypes and automatic weather stations... Those white spots are becoming fewer from year to year. This trip will remove another such spot.

The data of the institutes and weather bureaus have now become so all-inclusive that the radio is no longer enough for broadcasting weather reports: the teletype is now being replaced by the PhTAK.

The fervent monologue of the weatherman in defense of his science became our third interview.

The scientist gently passed his hand over the shiny gray surface of PhTAK, a photo-telegraphic apparatus for the reception of weather maps. On a wide moist strip of chemical paper which was barely moving along the screen an invisible draftsman was compiling a new map, stroke by stroke. That "draftsman" was a combination of electrical impulses transmitted by Moscow.

Such a map, continued the weather expert, is still better and more universally used than any other type of weather information. Looking at it, the captain gets an idea of the atmospheric conditions prevailing over vast areas on the ocean, and that makes it easier for him to chart the best and safest route for his ship. "I assure you, as soon as we get into the Pacific where the typhoons originate, dozens of stations will intercept our signals and the photo-telegraphic apparatuses will transmit the maps with our data. They will be most accurate as the ship will then be in the very area of the weather "kitchen-factory," and the majority of the weather stations are located not far from there." Which one of them was right was soon decided by the great Pacific Ocean, the ocean which, as the sailors say, "is only sometimes pacific but always great."

A TYPHOON CLOSE BY

The same warm and bright sun was shining on the Pacific as on the other seas of the southern hemisphere, the Celebes and Java, which the "A. I. Voyeykov" had just crossed. There was a light headwind, and wide, smooth ripples tossed the ship.

We knew that the ripples came in the wake of the typhoon which had passed this area several days before, and that the sunny and calm weather would be with us for a long time. Of that we were all certain, all except ... the weather expert. He immediately asked the meteorologists on duty to take soundings every hour and even more often, not every three hours as had been done since the beginning of the expedition.

The teleprinters and PhTAK were working at full speed without missing a single report or map. Every morning the weather expert compiled the weather map of "A. I. Voyeykov's" route. Thirty-nine days of traveling were now behind us. Thirty-nine maps informed us that everything ahead of us was quiet. But the 40th map, compiled on that day, and the 41st, the forecast for tomorrow, brought all the scientists of the expedition and the captain's assistants to the chart house.

Photo caption:

The white cylinder is a compact automatic meteorological station. At the right moment, the top cover is thrown open by a little motor and signals begin to flow into a recording device. Other instruments located nearby are the same time also "tuned in" on the atmosphere for the purpose of measuring the warm air areas, photographing the clouds, etc.

The weather expert excitedly told them about the isobars which would close in to form a danger spot the next day in the low-pressure area over the ocean. These spots were indicative of the formation of a new cyclone. Signal's of its approach had come from the ship's instruments: they showed falling pressure and a change in the course of the wind which was now blowing in a direction tangential to the isobars of the coming typhoon. It was felt that the wind was becoming increasingly stronger.

Photo caption:

Above the radar there were only clouds... The danger areas could be seen on the screen. The trace of a pilot balloon would flash occasionally... Engineers Eugen Karandzey (right) and Bozhikov readying the radar.

The new typhoon was forming somewhere in the East, in the area of the Marianne Islands. The American, Japanese and Australian meteorological stations were still silent but then the warning of an approaching typhoon was flashed to all the ships at sea from the Soviet weather ship "A. I. Voyeykov."

Photo caption:

Bathometers, instruments for testing the temperature of the water and taking required samples, are lowered thousands of meters into the ocean with a fast winch. Meteorologist Mikola Gontarev fastens the equipment to a cable before lowering it...

The ship had to change course. Anothe navigation map was placed on the desk in the chart house. That map says practically nothing about the land -- only about the coast line, the reefs and the dangers in the open sea. A very ordinary navigation chart... But this time it attracted the attention of all those present in the chart house. And not only because it could be used for charting a new course for the ship.

It was the area of the Japanese Okinawa archipelago. That name says a great deal: it immediately recalls to mind the struggle of the Japanese peasants against the American occupationists who turned that quiet green island into a huge military base. But now the navigation chart delved still further into that tragedy. It revealed several dozen red lines which looked as if some wag had suddenly decided to draw some geometrical figures on that piece of paper: squares, straight lines, trapezia, circles and different longitudinal and cross lines. But these "geometrical" figures were much too large and the space between them too narrow! Such red lines have an ominous and tragic implication on ocean maps...

The trapezia represent areas of moving air masses. Neither ships nor fishing boats can sail in those areas.

The squares are areas of submarine tactical training and antiaircraft fire. And the island of Okinawa itself is covered by a network of airplane silhouettes which appear like black crosses in a cemetery. Those are the American air fields. They are located on the most productive land taken from the population. They have isolated the island from another productive area, the sea, by invisible barriers.

Thus an ordinary navigation map, with much information about the sea and practically none about the land, recalled to mind the tragedy of Okinawa.

It was only 24 hours later that the other meteorological stations began to talk about the typhoon in the Pacific. The call of Japanese fishermen for help began to break into the storm warning signals; the full force of the tornado had caught them far out at sea.

One could not help thinking that the money spent every day on military maneuvers near Okinawa could be used to equip the Japanese fishing boats with modern apparatus that would enable them to intercept the danger signals in time.

The typhoon raged on for several days. Huge billows tossed the ship, and it looked as if the black clouds were touching the waves. Those were days of very high tension.

And one morning a Morse code message from Moscow broke through the roar of the waves into the earphones of the radio operator. It was a message of thanks for the timely warning against the typhoon. And for the first time the radiogram was addressed to the "weather ship A. I. Voyeykov" instead of the "expeditionary ship." (By C. Chumakov, Znannya ta Pratsya, No. 2, February 1960)

IV. GEOMAGNETISM

Experimental Testing of the Hypothesis of Magnetic Declination

The following is the full translation of a recent article by the prominent Soviet scientist V. V. Shuleykin.

Nine years ago we published our hypothesis on the nature of magnetic declination. At that time the first experimental work on the testing of this hypothesis was begun in our country. We assume that on the Earth's main magnetic field, with a moment directed along the planet's axis of rotation, there is superimposed a distorted magnetic field which is caused by the presence of electrical currents in the ocean, already discovered in 1935; another part of this distorted field is evidently caused by currents in the ionosphere directed along the contours of the continents. Initial research forced us to ascribe a rather modest role to ocean currents in this respect. In 1956, however, Soviet researchers discovered that the density of currents in the ocean (Indian Ocean) increases with depth and in 1957 for the first time we automatically recorded a similar increase in the density of currents with increasing depth in the Atlantic Ocean between Africa and South America. In this connection the question again arose about the extremely noticeable role played by oceanic telluric currents in the creation of magnetic declination. Opinions relative to their role became objective after L. A. Korneva proposed a new cartographic characterization of the distorted magnetic field: she drew maps of the latitudinal components of the intensity of the Earth's magnetic field.

Of special interest is the area of the Atlantic Ocean situated in the equatorial and tropical zones: passing through this area is the isoline Y = 10,000 gammas (that is, 0.1 oersted). It is of approximately elliptical form, with the small axis intersecting the magnetic equator. Within this isoline magnetic declination attains 22.4° while the latitudinal component of intensity is 0.11 oersted.

It was precisely in this part of the Atlantic Ocean that we made an experimental testing of our hypothesis. For the experiments we selected a region close to a point with the coordinates 1° S and 25° W, distinguished by the following important peculiarities: (a) the permanent South Trades current here is very stable, (b) without question meridional components of deep currents are absent, (c) the depth of the ocean does not exceed 3,600 m, (d) the wind is moderate and stable in direction. A simple and reliable photo-recording device was devised permitting us to get clear pictures of a part of the cartridge of the 127-mm ship's compass with course indicator and the dial of a small "Moskva" clock with minute and second hands. The pictures were taken every ten seconds on narrow positive movie film. An enlarged positive image of one of the photographs is shown in Figure 1. It was especially important to achieve parallelism in the diametral plane of the ship and the diametral plane of the recording instrument that was housed within a bronze casing with an airtight lid. To achieve this a dependable rudder with two fins (Figure 2) was attached to the capsule. Three sharp-pointed pins of nonrusting nonmagnetic steel, visible in the sketch, served (1) for the precise setting of the plane of the rudder relative to the compass course-indicator and (2) for safeguarding protruding parts of the mechanism for covering the capsule with a heavy lid under deck conditions.

The capsule, weighing 300 kg, was suspended by a cable on a swivel and during towing was well served by the rudder. At the time of the first series of experiments the angle of inclination of the cable to the vertical was 45°, while on the next day, at the time of the second series, it was 66°. From a special platform it was easy to see to it that the plane in which the cable lay above the water was parallel to the ship's diametral plane. At the time of the experiments the ship's course was continually recorded on a registering course indicator whose readings were systematically checked by means of individual readings on the repeater of the gyrocompass. A comparison of the true course of the ship with the readings (through a magnifying glass) on the movie film, drawn from the capsule, made it possible to determine magnetic declination at the depth at which the instrument was towed. In addition, for supplementary control, readings were made during the experiment of the compass course on the ship's main magnetic compass; corrections were introduced for deviation in the region of the equator. Thus we confirmed the value of magnetic declination at the ocean surface in the region where the experiments were made, determined from the navigational chart by means of interpolation between lines of equal declination.

By these independent methods we established that magnetic declination at a depth of about 2,000 m is at least 5° less than is magnetic declination on the ocean surface.

In view of the shallowness of towing in comparison with the height of the ionosphere, we must conclude that declination changes here only due to the field of telluric currents in the ocean, expressed in double fashion. Thus, on the basis of the work (6) (V. V. Shuleykin, Doklady Akademii Nauk SSSR, 119, No. 2, 257 (1958)), we use a scheme for increase in the density of currents i -- linear, as is shown in Figure 3. When examining these schemes we see that the latitudinal component of intensity of the Earth's magnetic field Y, at the depth of towing of the capsule z changed, firstly, because under the capsule there is not the entire area of the triangle ABC, involved in the creation of magnetic declination at the ocean surface, but only of the area of the trapezium KLCB; secondly, because above the capsule there was the triangle ALK which was absent under conditions prevailing at the ocean surface. Both of these causes facilitate a decrease in the latitudinal component of the intensity of the Earth's magnetic field at the depth z of towing the capsule (in absolute value). For simplicity, in Figure 3 it is assumed that i increases from the value 0.

Let the latitudinal component here consist of two values: the value of y, created by currents in the ocean and therefore changing at depth in accordance with the scheme of their distribution in depth (Figure 3) and some value Y, which according to our present-day concepts are created by currents in the ionosphere (also associated with the distribution of oceans and continents on the Earth). In view of the smallness of depth of towing in comparison with the height of the ionosphere, it is possible to consider Y as constant from the surface of the ocean to this depth (possibly, also to the bottom of the ocean).

Let's designate by ζ the ratio of the depth of towing z to the depth of the ocean H, $\zeta = z/H$. Then, on the basis of the ideas expressed, and using the scheme in Figure 3, it will be possible to get a simple ratio:

$$Y_1 = Y + y = Y + y_0(1 - 2\zeta^2), \qquad (1)$$

in which y_0 designates the value y at the surface of the ocean when $\zeta = 0$. The full significance of the latitudinal component at the surface of the ocean according to (1) will be:

$$Y_0 = Y + y_0, \qquad (2)$$

and, consequently, the difference between Y_0 and Y_1 is expressed as follows:

$$Y_0 - Y_1 = 2y_0\zeta^2. \qquad (3)$$

But the same difference can be expressed differently: through the functions of angles of magnetic declination at the surface of the ocean (D_0) and at the depth of towing of the capsule (D), to wit:

$$Y_0 - Y_0 = \frac{Y_0}{\sin D_0}(\sin D_0 - \sin D). \qquad (4)$$

We equate the right parts (3) and (4) and make simple transpositions. Then we get the ratio between y_0 and Y_0.

$$\frac{y_o}{Y_o} = \frac{1}{2\zeta^2}\left(1 - \frac{\sin D}{\sin D_o}\right). \qquad (5)$$

Substituting numerical values, found from our experiments in the ocean, we get $y_o/Y_o \approx 1/3$.

Thus, telluric currents in the ocean create here approximately one-third of the latitudinal component of the intensity of the Earth's magnetic field. In this connection it is necessary to assume that the missing two-thirds is accounted for by currents in the ionosphere, also associated with the distribution of oceans and continents on the Earth.

The conclusions following from the experimental work accomplished show that our basic theoretical concepts were justified and that our next problem is the refinement of the method of recording magnetic declination in the depths of the ocean. At the same time it is necessary to organize research pertinent to the role of currents in the ionosphere in the creation of the latitudinal component of the Earth's magnetic field.

The author wishes to express his sincere gratitude to staff elements of the Soviet Navy for cooperation in establishing research activities aboard the expeditionary-oceanographic vessel "Sedov," to B. R. Lazarenko and Ye. S. Borisevich for assistance in the fabrication of mechanisms, to A. V. Lakedemonskiy for supervision of the casting of the bronze capsule, to L. F. Vereshchagin and A. A. Semirchan -- for testing of the capsule at the Institute of High Pressures of the Academy of Sciences of the USSR and for the extremely modern design for sealing of the flanges. CPYRGHT ("Experimental Testing of the Hypothesis of the Nature of Magnetic Declination," by Academician V. V. Shuleykin, Doklady Akademii Nauk SSSR, Vol. 130, No. 5, 1960, pp. 1015-1018)

V. OCEANOGRAPHY

Report on a Planned Soviet Bathysphere

The following is substantially the complete text of a report on a newly developed Soviet bathysphere.

"...A new bathysphere has been developed by workers at the Leningrad Institute "Giprorybflot" (State Institute for the Design and Planning of the Fishing Fleet). Its steel body is designed to withstand the immense pressure of sea water and the special glass in the portholes is 65 mm thick. Because of this the Soviet bathysphere can be submerged to a depth twice as great, for example, as the Italian bathysphere, and three times as great as the Japanese bathysphere." CPYRGHT

"It should also be mentioned that the new bathysphere is equipped with modern instruments for the investigation of sea water, special movie and photo apparatus, a reliable system of steering and control, and emergency equipment."

"The new underwater laboratory will render great assistance to Soviet icthyology in the study of fish resources." ("At a Depth of 600 Meters," Nauka i Zhizn', No. 12, 1959, pp. 70-71)

Standards for Radar Buoys and Beacons Used in Sea-Current Studies

An article by V. V. Dremlyug on selecting the shapes and sizes of radar buoys and beacons used in sea-current observations is summarized in a Soviet abstract journal. It gives the following information.

Tests have established that a radar buoy with pyramidal reflectors is suitable for observations of currents at distances of up to one mile and with wave conditions in up to a No. 3 sea. A radar beacon with a pyramidal reflector can be used for observations up to 3-4 miles based on the vertical aspect of the beacon. With a 15 degree pitch, the beacon's radar visibility is lowered from 4 to 1.5 miles. Found to be best was a radar beacon with a rhombic reflector, which with a pitch of 10-15 degrees and a height of about 2 meters above the water, was visible at a distance of 3 miles. With an increase of the height of the reflector above the water from 4-5 meters and an increase in the vertical aspect of the beacon, the distance for its observation reaches 6-7 miles. (Selection of the Shape and Dimensions of Radar Buoys and Beacons Used for Sea-Current Observations, by V. V. Dremlyug; Sb. tr. Leningr. basseyn. pravl. Nauchno-tekhn. o-va transp. /Collection of Works of the Leningrad Basin Administration of the Scientific-Technical Society of Transports/, No. 4, 1958, pp. 87-90. From Referativnyy Zhurnal-Mashinostroyeniye, No. 1, 1960, Abstract No. 2744, p. 364)

VI. ARCTIC AND ANTARCTIC

Ice Reconnaissance Active in the North

The following is the full text of a recent dispatch in Izvestiya.

"The well-known polar flier V. Perov reports the following by radio from on board an 'IL-14' aircraft, now completing a research flight over the ice of the Laptev, Chukchee and East Siberian seas: 'The hydrologists and I are conducting an ice reconnaissance in the eastern part of the Arctic. Four flight lines have been completed and we are now on the fifth. Yesterday we flew over the drift station

Severnyy Polyus-8 and dropped the latest mail to the polar researchers. Not far from the SP-8 we could see an abandoned American scientific drift station.'"

"In the western sector of the Arctic a reconnaissance is being made by the crew of an 'IL-14' aircraft commanded by the experienced polar flier V. Mal'kov and the pilot A. Yefimov. With the group of scientists aboard they have flown around the entire Kara Sea and the northern part of the Barents Sea and the region around the Pole."

"In addition, two aircraft piloted by the fliers I. Baranov and Ya. Nagorniy have conducted an ice reconnaissance in the Far East over an extensive period."

"The scientists of the Leningrad Arctic and Antarctic Scientific Research Institute are determining the limits of ice of various ages and forms, observing the movement of ice masses from the aircraft and refining predictions for the 1960 navigation season. Because of their work seamen will receive important operational data concerning ice conditions along the entire Great Northern Route from Murmansk to Vladivostok." ("Underwing -- The Frozen Sea," by M. Filipenin, Moscow, Izvestiya, 2 March 1960, p. 6)

Structural and Historical Development of the Antarctic

The following principal stages may be noted in the history of the geologic development of Antarctica.

1. The Pre-Cambrian stage of sediment accumulation (Maud complex, folding, metamorphism and the formation of intrusions, ending in the formation of the ancient Eastern Antarctic platform. Two principal cycles (or phases) of intensive activity are distinguished: (a) the Victoria cycle (granites and others); (b) the Mawson cycle (predominantly charnockites, etc.).

2. The Upper Proterozoic or Lower Proterozoic stage: development of the Ross geosyncline at the western edge of the platform, the deposition of a stratum of the Ross system, the development of the Rosside folded system (possibly continuing into the Flinders system in Australia), the formation of the intrusive Admiralty complex and others. On the platform, deposition of the Sandau series.

3. The Paleozoic stage, still not subdivided: the development of the Falkland geosyncline and its branches -- (1) the Orkney, passing through the Shetland Islands, the western tip of Antarctica and the Australian Alps, and (2) the Marion -- between Antarctica and Africa. Possible Caledonian folding and doubtlessly Hercynian. On the platform, deposition of the Beacon stratum. As a result of the

closing of the geosyncline and folding of Antarctica it was joined into a single platform with Brazil, Africa and Australia. Younger folding processes have made no appearance here.

4. The Mesocenozoic stage, for the time being still not subdivided: the development of the Bellingshausen geosyncline, connected with the Andes and New Zealand, Mesozoic (Pacific Ocean) folding, intrusive activity (Graham's cycle), the closing of the geosyncline, formation of the Antarctic-Andes system. On the platform -- faults, volcanic activity, formation of silts of dolerites (Ferraro (?) volcanic cycle).

5. Neotectonic stage (Neocene -- Quaternary Period): large block uplifts and subsidences, forming the Great Antarctic Horst and Graben of the South Pole, formation of the contours of the Antarctic shelf and (in general form) of the continent, the development of large morphological elements on the bottom of the surrounding oceans and of recent (right up to the present day) vulcanism (McMurdo cycle).

Eastern Antarctica is a unified continental massif with very complex relief, broken up by young movements into a series of horsts and grabens.

The South Pole is situated within the limits of a deep graben, inasmuch as the bedrock here only rises 275 m above sea level. ("Structural and Historical Development of the Antarctic," by Academician O. S. Vyalov, Academy of Sciences of the Ukrainian SSR, Kiev, Dopovidi Akademii Nauk, No. 8, 1959, pp. 878-880)

Soviet Polar Geophysical Activity

A two-page spread of photographs showing the camp layout and ground installations of the Soviet geophysical station on Heiss Island, Franz Josef Land, appeared in a February issue of the Bulgarian periodical Bulgaro-Suvetska Druzhba. The article accompanying the photographs follows.

"At the beginning of the International Geophysical Year, the northernmost geophysical observatory was constructed on Heiss Island in the center of the archipelago of Franz Josef Land. The observatory and "Druzhniy" settlement are situated on the shore of a lake along which were erected high towers, a radio station, scientific stands, a mess hall, and housing quarters."

"The geophysicists, seismologists, meteorologists, aerologists, and radio operators employed in the observatory are engaged in extensive operations. An important sector of scientific research work involves study of the upper strata of the atmosphere by means of rockets. Meteorological rockets are launched from the rocket field on Heiss Island." ("The Northernmost Geophysical Observatory," Sofia, Bulgaro-Suvetska Druzhba, No. 3, February 1960, p. 13)

- END -